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Summary Report of

UTILIZATION RESEARCH *and* DEVELOPMENT

FISCAL YEAR 1967

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February 1968

Summary Report of UTILIZATION
RESEARCH
and
DEVELOPMENT

CONGRESSIONAL DIRECTIVE

This report is submitted in further response to the request made by the Committee on Appropriations in its report to the Senate on the Agricultural and Farm Credit Administration Appropriation Bill, 1960 (Report No. 330). This request, on page 4, paragraph 3 of the report under the section entitled "Utilization Research," states:

"Further, the committee specifically requests that it be kept advised by an annual summary report on research developments, including the work in progress at these laboratories, proposed new work, and on projects to be discontinued due to completion of work or lack of results with the reasons for discontinuance. It is the hope of the committee that it will be kept better advised not only as to specific accomplishments in the field of utilization research but also as to fiscal requirements at these installations."

Previous reports concerning the utilization research activities of the Department, made in compliance with this request, have been submitted for Fiscal Years 1959 through 1966.

CONTENTS

| | | |
|-----|---|----|
| I | Aim and Operation of Utilization Research | 2 |
| II | Making Utilization Research Information Available | 3 |
| III | Cooperative Research with Other Organizations | 8 |
| IV | Program Modification to Meet Changing Needs | 10 |
| V | Current Utilization Research Program. | 18 |
| VI | Financial Information | 22 |
| VII | Selected Research Accomplishments | 25 |

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

SUMMARY REPORT OF UTILIZATION RESEARCH AND DEVELOPMENT

Fiscal Year 1967

I AIM AND OPERATION OF UTILIZATION RESEARCH

Utilization research aimed at expansion of agricultural markets and reduction of processing and distribution costs can increase farm income, benefit domestic consumers, and contribute to U. S. programs of assistance to developing countries. Such research can help to bring into balance the supply of, and demand for, farm commodities. In pursuing its objectives, USDA's utilization research and development effort is directed to: (a) devising new food products that are attractive and economical, and fit the distribution requirements in worldwide market channels; (b) improving functional properties of the natural fibers, cotton, wool, and mohair, to better meet consumer needs; (c) developing more economic and more suitable processed feed products needed in the expansion of the poultry, dairy, and livestock industries; and (d) seeking broadened and profitable industrial uses for agricultural materials.

The Department's utilization research investigations in Fiscal Year 1967 were conducted primarily in Federal facilities in the United States, consisting of four divisions, or regional laboratories (New Orleans, La.; Albany, Calif.; Wyndmoor, Pa.; and Peoria, Ill.) and twelve field laboratories (Beltsville, Md.; Washington, D.C.; Waltham, Mass.; Lexington, Ky.; East Grand Forks, Minn.; Olustee and Winter Haven, Fla.; Raleigh, N.C.; Weslaco, Tex.; Pasadena, Calif.; Honolulu, Hawaii; and Puyallup, Wash.). A fifth regional laboratory, at Athens, Ga., is still under construction and has not yet been staffed. Research is done also through contracts, grants, and memoranda of understanding with State Experiment Stations, universities, private research institutions, and industry. Other supporting research is conducted in foreign research institutions through funds generated by the P.L. 480 program (Agricultural Trade Development and Assistance Act of 1954, 83rd Congress, 2nd Session, as amended).

II MAKING UTILIZATION RESEARCH INFORMATION AVAILABLE

Continuing, positive emphasis is placed on disseminating the results of utilization research to interested segments of the agricultural industry. The following summary illustrates the uses made of various information media in F.Y. 1967:

- 111 patents granted
- 934 technical papers published
- 724 speeches, press releases, and appearances on radio and television
- 42 formal conferences with industry
- 15 public-service exhibits
- 6,577 technical visitors to UR&D installations

Continuing efforts are made also to acquire information on the interests and activities of outside groups concerned with the processing of agricultural materials. For example, the regional laboratories collaborate with numerous trade and industry organizations in sponsoring periodic meetings, to exchange ideas and seek better answers to processing problems.

Utilization Research Illustrative Materials

Various special exhibits were prepared and shown during F.Y. 1967. These were used to inform groups in agricultural industry and related fields of USDA developments in food, fiber, and industrial products made from agricultural sources, and of research to solve basic problems affecting the use of agricultural commodities. Illustrative examples are:

| Group Concerned | Subject | Location |
|---|---|-------------------|
| American Oil Chemists' Society | Properties and uses of crambe oil | Philadelphia, Pa. |
| National Flaxseed Processors' Assn., Linseed Oil Technical Subcommittee | Properties and uses of crambe oil | Peoria, Ill. |
| International Conference on Soybean Protein Foods | Oriental foods prepared by fermentation of soybeans | Peoria, Ill. |
| University of California Rice Experiment Station | New rice products | Biggs, Calif. |
| Committee on Wool Knit Goods, Oregon wool industry | WURLANized wool | Roseburg, Oreg. |

Utilization Research Illustrative Materials (contd)

| Group Concerned | Subject | Location |
|--|---|----------------------|
| American Academy of Allergy | Allergic serum transfer tests in non-human primates | Palm Springs, Calif. |
| California Cooperative Extension Service | New foods | Fresno, Calif. |
| University of California Department of Nutrition | New foods | Berkeley, Calif. |
| Northwest Cannery and Freezers Assn. | Experimental canned and frozen fruits and vegetables | Portland, Ore. |
| Western Washington Horticultural Assn. | Experimental packs of frozen berries | Puyallup, Wash. |
| Lewis County (Wash.) Crop Improvement Assn. | Experimental packs of frozen berries | Chehalis, Wash. |
| National Cottonseed Processors Assn. | Cottonseed protein research | Phoenix, Ariz. |
| Culinary Art Show | Food products from grapefruits, sweet-potatoes, and peanuts | New Orleans, La. |
| Texas State Fair | High-protein rice flour, deep-milled rice | Dallas, Tex. |

A motion picture illustrating various accomplishments of the Western Regional Research Laboratory was prepared and shown to numerous professional groups.

Formal Conferences with Industrial and Other Organizations

During F.Y. 1967, more than 40 formal conferences were sponsored by the regional laboratories, often in collaboration with industrial and other outside groups. The following examples are illustrative:

| Conference | Sponsors | Attendance | Location |
|---|---|------------|-------------------------|
| 1966 Conference on Citrus Chemistry and Utilization (10/5/66) | USDA | 86 | Winter Haven, Fla. |
| 1966 Technical Session on Cane Sugar Refining Research (10/10-11/66) | USDA, Cane Sugar, Refining Research Project, Inc. | 69 | New Orleans, La. |
| Cottonseed Processing Clinic (2/13-14/67) | USDA, Mississippi Valley Oilseed Processors Assn. | 98 | New Orleans, La. |
| Workshop Conference on Vapor Phase Finishing of Cotton (2/24/67) | USDA | 159 | New Orleans, La. |
| 13th Annual Joint Conference of Coop. Soybean & Cottonseed Mills (4/3-5/67) | USDA | 300 | Lake of the Ozarks, Mo. |
| 7th Cotton Utilization Research Conference (4/26-28/67) | USDA | 232 | New Orleans, La. |
| 16th Annual Potato Utilization Conference (7/27-29/66) | USDA, United Fresh Fruit & Veg. Assn., Colo. State U., San Louis Valley Potato Administrative Comm. | 125 | Ft. Collins, Colo. |
| 8th Dry Bean Research Conference (8/11-13/66) | USDA, Natl. Dry Bean Council, Michigan Bean Shippers Assn., Michigan State U. | 91 | Bellaire, Mich. |
| Citrus Research Conference (12/6/66) | USDA, citrus industry | 70 | Pasadena, Calif. |

Formal Conferences with Industrial and Other Organizations (contd)

| Conference | Sponsors | Attendance | Location |
|--|--|------------|-----------------------|
| American Bakers Assn. Technical Liaison Committee (12/7-9/66) | USDA | 56 | Albany, Calif. |
| 1st Safflower Utilization Research Conference (5/25-26/67) | USDA, West Coast Oil-seeds Development Committee | 75 | Albany, Calif. |
| Dried Fruit Industry Research Advisory Committee (3 times during year) | USDA, dried fruit industry | 60 | San Francisco, Calif. |
| Rice Utilization Research Conference (6/29/67) | USDA | 30 | Albany, Calif. |
| Lemon Products Technical Committee (4 times during year) | USDA, lemon industry | 60 | Pasadena, Calif. |
| Evaporated Milk Research Workshop Seminar (10/13/66) | USDA, Evaporated Milk Assn. | 50 | Washington, D.C. |
| Eastern Expt. Sta. Collaborators' Conference on Proteins (10/18-19/66) | USDA | 75 | Wyndmoor, Pa. |
| Meat Packers & Processors Conference (3/8/67) | USDA, Pennsylvania State U., Montgomery Co. (Pa.) Agr. Extension Assn. | 75 | Wyndmoor, Pa. |
| Cigar Mfrs. Assn. of America Research Subcommittee (4/11/67) | USDA, Cigar Mfrs. Assn. | 26 | Wyndmoor, Pa. |
| Conference on Nature and Properties of Milky Disease Organisms of the Japanese Beetle (10/6-7/66) | USDA, workers at Baylor U., U. Minnesota, Michigan State U., Kansas State U. | 19 | Peoria, Ill. |

Formal Conferences with Industrial and Other Organizations (contd)

| Conference | Sponsors | Attendance | Location |
|---|--|------------|--------------|
| International Conference on Soybean Protein Foods (10/17-19/66) | USDA, AID, NIH, UNICEF, FAO, Soybean Council of America, Amer. Soybean Assn., Natl. Soybean Processors Assn. | 276 | Peoria, Ill. |
| Natl. Flaxseed Processors Assn., Linseed Oil Tech. Subcommittee (6/21-22/67) | USDA, Natl. Flaxseed Processors Assn. | 31 | Peoria, Ill. |
| Amer. Corn Millers Federation, Research Liaison Comm. (6/27/67) | USDA, Amer. Corn Millers Federation | 52 | Peoria, Ill. |

Rural Areas Development Program

During F.Y. 1967 the regional laboratories made continued efforts to foster the establishment of agricultural processing enterprises in rural areas. Technical or economic advice was provided on such subjects as the following:

Starch-based polyethers for rigid urethane foam (Southerlin, Ore.)
 Enzymatic conversion of wheat flour to glucose (Kent, Wash.)
 Oriental foods from soybeans (La Porte, Ind.)
 Chemicals and paper pulps from tobacco processing wastes (Maysville, Ky.)
 Industrial uses for crambe oil (Quarryville, Pa., Hayti, Mo., and Farmer City, Ill.)
 New starch-protein glue for southern pine plywood manufacture (Minden, La.)
 Fractionation of alfalfa leaves and stems for cattle and poultry feeds (Darr and Odessa, Nebr.)
 Handling and processing of mechanically-harvested cherries (Michigan, New York)
 Ultraviolet radiation pasteurization of farm-pressed cider (various states)
 Improved methods for peeling and processing apples (cooperative in Peach Glen, Pa.)
 Advice on the suitability of the Babygold peach variety for processed products (10 states)
 Technical assistance to community maple sirup processing plants (Pennsylvania, New York, Ohio, Minnesota, Wisconsin, Massachusetts, Michigan, Indiana)
 Dehydration of sweetpotatoes for animal feeds (New Mexico)
 Naval stores products from pine stumpage (Arizona)
 Sweetpotato processing (Louisiana, North Carolina, Virginia)

III COOPERATIVE RESEARCH WITH OTHER ORGANIZATIONS

Cooperative work with other groups is undertaken to develop new products, to improve existing products and processes, to devise economic processes for product manufacture, to evaluate products and processes, and to explore new outlets for agricultural products. These cooperative efforts contribute to early commercialization and broadened usage. Examples of cooperative research and development are as follows:

| Project | Cooperators with USDA |
|---|--|
| Use of lead and zinc salts for improving the rot-, flame-, and weather resistance of cotton | International Lead-Zinc Research Organization |
| Improved production and performance characteristics of chemically-treated cotton batting | Textile Waste Assn., Nat. Cottonseed Products Assn., Natl. Batting Institute, Natl. Cotton Council |
| Food products for developing countries from cottonseed and peanut flours | Agency for International Development |
| Improved orange and grapefruit powders | Florida Citrus Commission |
| Increasing the capacity of rice dryers | Butte County (Calif.) Rice Growers Assn. |
| Evaluation of methods for pasteurizing egg yolk | Seymour Packing Co. and Standard Brands, Inc. |
| Rapid evaluation of tomato processing quality | Canners League of California, University of California |
| Development of machine-washable wool blankets | Faribo Blankets |
| Chemical constituents of lemon juice | Lemon Products Technical Committee |
| Effect of varietal and cultural factors on processed potato quality | Red River Valley Potato Growers Assn., Minnesota and North Dakota Agr. Expt. Stations |
| Improved explosion-puffed food products | Tronchemics Research, Inc. |
| Dehydrated pumpkin as canned pie-filler | Cannon Canning Co. |

| Project | Cooperators with USDA |
|---|--|
| Improved handling and storage of maple sap on farms and at evaporating plants | J. L. Sipple & Son |
| Foam-spray drying of cottage cheese whey | Maryland-Virginia Milk Producer Assn. |
| Constituents of cigar leaf and smoke | Cigar Manufacturers' Assn. of America |
| Standard physical test methods for leather | Army Quartermaster Laboratory |
| Development of high-amylose corn for industrial use | Bear Hybrid Corn Co. |
| Full-fat soy flours for developing countries | Agency for International Development |
| Utilization of linseed oil in coating compositions | Natl. Flaxseed Processors Assn. |
| Upgrading of castor meal and development of new uses for castor oil | Plains Cooperative Oil Mill |
| Commercial-scale testing of USDA process for dry fractionation of alfalfa | Nebraska State Dept. of Economic Development, Platte Valley Products, Inc. |

IV PROGRAM MODIFICATION TO MEET CHANGING NEEDS

Planning and Advisory Activities

The USDA program of utilization research on farm commodities is the product of extensive planning that is continually updated. Its administration is the direct responsibility of a deputy administrator of the Agricultural Research Service, his supporting staff, and the directors of the four regional research laboratories. A Program Planning and Evaluation Staff of ARS, composed of economic specialists, assists this administrative group in evaluating the appropriateness and commercial feasibility of proposed and existing utilization research projects. Information and guidance is sought from various other sources both within and without the Department. Among the advisory groups that oversee the program, the following may be mentioned:

National Program of Research for Agriculture. Pursuant to a directive from the Senate Committee on Appropriations (Senate Report No. 156), in 1965-1966 a joint study was made by representatives of USDA, State Agricultural Experiment Stations, and the land-grant colleges, to look into all areas of agricultural research conducted by the Department and the State Experiment Stations. A report of the study, entitled "A National Program of Research for Agriculture" and essentially completed in F.Y. 1966, includes an appraisal of the current status of agricultural research and definition of future agricultural needs.

To implement the recommendations of the National Program, the establishment of 32 task forces was recommended. Of the 15 task forces that have already been set up, the following are concerned with utilization research: Forestry, cotton, swine, soybeans, dairy, beef, food safety, food and nutrition, pollution in relation to agriculture, poultry, and forage, range, and pasture. Seventeen additional task forces are planned, of which the following will be concerned with utilization research: Peanuts, foreign aid and market development, fruits, vegetables, corn and grain sorghum, wheat and other small grains, rice, sugar crops, tobacco, minor oilseeds as well as miscellaneous and new crops, and sheep and other animals.

Committee on Agricultural Science. An advisory group established in 1962, of 16 eminent scientists representing such disciplines as biochemistry, physiology, rural sociology, marketing, and economics. This group, which includes representatives of State universities and Agricultural Experiment Stations, evaluates the quality of research and the factors essential to a favorable scientific environment, and makes recommendations concerning USDA research in basic sciences.

Agricultural Research Planning Committee. A 15-member advisory committee established in 1964, composed of USDA's Director of Science and Education; six representatives from USDA research agencies; six representatives of, or nominees of, State universities and land-grant colleges; one member nominated by the National Academy of Sciences; and one member nominated by the Office of Science and Technology. This committee primarily assists in planning, evaluating, and coordinating unified long-range agricultural research programs, and in delineating the appropriate areas of responsibility of Federal and State agencies that carry out these programs.

USDA National Agricultural Research Advisory Committee. An 11-member advisory committee with broad national interests in all phases of agriculture, that evaluates the Department's entire research program and offers suggestions, particularly on policy matters, for changes in the program. Six of the committee members are representatives of producers or producer organizations.

National Advisory Committee on Rural Areas Development. An advisory committee representing agricultural industries, farmers, educational institutions, finance groups, and regional representatives, that makes recommendations for the greater development of rural areas.

Commodity and Functional Advisory Committees. There are 14 commodity and functional advisory committees, authorized under the Research and Marketing Act of 1946, that offer suggestions on present work, make recommendations on needed future direction of research, and assure more effective communications with the many organizations interested in agricultural research. Of these committees, the following are concerned with utilization research: Animal and animal products, cotton, forestry, grain and forage crops, horticultural crops, oilseed and peanut crops, sugar crops, tobacco, and utilization research and development.

State Agricultural Experiment Stations. The directors and designated technical collaborators of the State Agricultural Experiment Stations, acting in four regional groups, assist in planning research activities of mutual Federal and State interest.

Agricultural Associations and Industry Groups. Advice is sought from, and information is exchanged with, all segments of the agricultural industry, including growers, shippers, processors, and distributors, concerning the many problems involved in the profitable development of new or improved uses for agricultural commodities.

Consumer Interests. Information on consumer desires for new or improved products, and on evaluations of such products, is sought through contacts with consumer groups of national and regional scope. Other USDA groups--the Economic Research Service, the Federal Extension Service, and the ARS market and consumer use research groups--provide advice on consumer needs and market trends.

Program Appraisal and Redirection

The utilization research program is continually reviewed to assess its fruitfulness. Investigations that have reached their objectives are discontinued. Investigations that have passed the point of maximum returns, or are otherwise relatively unproductive, also are discontinued so that the resources may be more effectively applied to new programs. More promising investigations are established or intensified, either by reduction of effort on projects of lesser importance or by use of such new resources as may become available. Examples of the redirection of research effort are shown below:

| Research Redirected | Research Initiated |
|--|---|
| <u>Cereal and Forage Crops</u> | |
| Starch-foam plastic for insulation and packaging use | Mixed starch-polyurethane plastics |
| Air classification of flour | New dry-milling processes for wheat |
| Removing radio-nuclides from wheat flour and millfeeds | New processing systems for producing food and industrial products from grain sorghum and oats |
| Distribution of rice constituents in consecutive layers of the kernel, and evaluation of selected kernel fractions | Chemical and physical properties of whole and fractionated rice kernels, in relation to new food, feed, and industrial uses |
| Incorporation of flavor-contributing constituents into bread | Fermentative capacity of frozen unbaked bread |
| Wheat components that limit the use of dry milk solids in bread | Mechanism of wheat flour maturation |
| Bulgur and peeled wheat food products for specific export and domestic markets | High-protein food products from wheat |
| Coumarins and other phenolics in processed forage crops | Improved assays for unidentified growth factors in alfalfa |
| Individual wheat proteins involved in changes in flour during mixing and baking | Process variables in the production of high-protein rice flour for use in processed foods |

Research Redirected

Research Initiated

Cotton, Wool, and Other Fibers

Cotton fiber property changes that affect uptake of alkali solutions

Influence of internal and external restraints on the capacity of cotton fibers to absorb swelling solutions

Removing short fibers and improving fiber parallelization at textile carding machines

Producing a continuous, uniform supply of completely individualized cotton fibers

Wool fabrics with permanent high luster

Synergism between fluorocarbon and hydrocarbon repellents for treating wool and mohair

Fruits and Vegetables

Fruit pigments and their changes during processing

Improved high- and low-moisture dried fruits

Relation of cell wall organization to texture in processed fruit products

Use of new processing concepts to improve desert grapefruit products

Drying conditions as related to storage stability and quality of dried citrus products

New freeze-dried products from citrus and other subtropical fruits

New procedures for manufacture of dehydrated flakes from different sweetpotato varieties

Carbohydrate transformations in sweetpotatoes, and their effect on processed products

Oilseeds

Aldehyde oil products from soybean and linseed oils

Polyesters and polyamides from soybean and linseed oils

Improving the performance of confectionery fats

Cocoa butter substitutes from stearine obtained in cottonseed oil winterization

Research Redirected

Research Initiated

New and Special Plants

Screening for new pulp fiber crops

Domestic sources of rotenoid insecticides

Reactions of epoxides and ozonization products of resin acids and their derivatives

Chemistry of photoperoxides of pine gum

Poultry, Dairy, and Other Animal Products

Factors affecting the quality of freeze-dried poultry meat

Post-mortem changes in poultry muscle proteins and their influence on poultry meat product quality

Genetic variance in milk proteins

Properties of milk complexes, particularly the casein micelle and the fat globule membrane

Basic research on development of low-fat and other types of cheese

Identification and control of salmonella bacteria in dairy products

Solubility properties of whole milk powder

Improvements in flavor quality of whole milk powder

Basic studies of bacterial lipases at low temperature

Control of salmonella in meat and meat products

Status of Research Projects

Summary Statement

| | Active at beginning FY 1967 | Initiated or revised | Terminated | Active at end FY 1967 |
|--------------------|-----------------------------------|----------------------------|------------|-----------------------------|
| Domestic | 440 | 134 | 133* | 441** |
| Foreign (P.L. 480) | 163 | 22 | 36 | 149 |
| Total | <u>603</u> | <u>156</u> | <u>169</u> | <u>590</u> |

*115 projects were terminated because the objectives had been wholly or substantially achieved; the remaining 18 projects were terminated because the results were unpromising, or because the work was superseded by research of higher priority.

** Includes 181 domestic contract and grant projects, 15 projects wholly or partly supported by industry (fellowships and direct financial support), and 4 projects supported by funds transferred from other Federal agencies.

Commodity Classification of New Projects Undertaken in FY 1967

| | Domestic | Foreign | Total |
|--|-----------|----------|-----------|
| Cereal and forage crops | 22 | 4 | 26 |
| Cotton, wool, and other fibers | 23 | 7 | 30 |
| Fruits and vegetables | 25 | 2 | 27 |
| Oilseeds | 12 | 7 | 19 |
| New and special plants | 27 | 1 | 28 |
| Poultry, dairy, and other animal products | <u>25</u> | <u>1</u> | <u>26</u> |
| Total | 134 | 22 | 156 |

New Research Initiated with Increased Appropriations

Cereal and Forage Crops

Investigation of the relationship of wheat starch granule properties to variations in baking quality of flours (in-house)

Cotton, Wool, and Other Fibers

Development of improved durable press, all-cotton fabrics through the application of polymers to cotton yarns and through the development of better fabric structures (in-house)

Fruits and Vegetables

Development of new and improved methods for processing mechanically harvested dates (in-house)

Investigations on conditions for drying as related to the storage stability and quality of foam-mat dried citrus products (in-house)

A study of off-flavor development in processed citrus juice in relation to the lipid composition of the suspended matter (in-house)

A study of non-enzymic browning in model systems to develop methods of blocking the reactions involved in flavor deterioration of orange juice crystals (contract)

Development of an oxalate or other organic acid index for estimating the amount of peel solids in orange and grapefruit paste, puree, and juice products (contract)

Study of the enzyme reactions in fresh and processed citrus to increase the natural flavor of citrus products (in-house)

Consumer acceptance of foam-mat dried grapefruit juice crystals (contract)

Oilseeds

Exploratory studies of safflower seed components affecting feed uses of safflower meal (in-house)

New and Special Plants

Increased effort on development of new industrial products from crambe oil (in-house)

Conversion of rosin, resin acids, and pine gum derivatives into polyols for use in polyurethane applications (in-house)

New and Special Plants (contd)

Production of useful chemicals from terpenes and resin acids by free radical addition of functional groups (in-house)

Isolation and characterization of the major unidentified components of pine oleoresin and rosin to aid in the increased utilization of gum naval stores (in-house)

Investigation of the chemistry of photoperoxides of pine gum to develop useful intermediates for the chemical industry (in-house)

Investigations to expand the use of gum rosin and its derivatives in the adhesives industry (contract)

Investigations of methods for purifying sweet sorghum juices which will permit practical recovery of their sugar content (in-house)

V CURRENT UTILIZATION RESEARCH PROGRAM

USDA's utilization research program is directed to finding new or improved uses and improved processing methods for agricultural commodities through basic, applied, and development research. As previously indicated, it is subject to continual review and appraisal at all levels, from research line projects--limited assignments involving up to several man-years of effort for periods of not more than five years--up through broad general areas of activity. As examples of program changes in the latter category, it may be mentioned that increasing attention is being given to food safety, with major emphasis on elimination of salmonella bacteria from foods and feeds, and on control of toxins from fungi in foods and feeds; to development of products specifically suited to cash export markets; and to development of modifications in the processing of agricultural commodities that will minimize stream pollution.

The following listing of subject fields will illustrate the general nature of the current program:

Cereal and Forage Crops. Emphasis on development of new uses for corn and wheat, with concurrent effort on rice, barley, oats, sorghum, and alfalfa and other legume and grass forages:

New and improved food products -- new fermented wheat foods suitable for improving nutrition levels; improved frozen cereal products through reduction of microbial contamination in milled flours; new foods by "deep milling" of rice; new foods by upgrading wheat mill byproducts.

Improved feeds -- feed products with low fiber and high nutritive content from milled wheat byproducts; fractionation of dehydrated alfalfa to upgrade feeds for poultry and ruminants; studies of various growth factors in alfalfa products; improved coastal Bermuda grass products.

New industrial uses -- new plastic foams and graft polymers from cereal grains for industrial uses; development of improved pine plywood bonding materials from soybean meal, blood, and dialdehyde starch; modified flours for paper improvement; polysaccharide gums for oil well drilling fluids, and other industrial polymers, by fermentative processes; factors involved in producing spores of bacterial pathogens useful for controlling Japanese beetles when grown on grain-based media.

Cotton, Wool, and Mohair. New functional properties imparted to cotton, wool, and mohair through chemical, physical, and mechanical processing research and development, supported by comprehensive fundamental studies of fiber properties and modification:

Cotton chemical processing -- improved wash-wear and durable-press finishing agents for cotton; chemical treatments for cotton batting to provide flame resistance and resilience; improvements in cotton batting for upholstering and insulating uses; new ways to improve abrasion resistance and drying properties of cotton; processes to increase moisture absorptivity to give better wearing comfort to cotton garments; improved coated cotton fabrics with optimum strength-weight characteristics for outdoor uses; durable oil- and water-repellent finishes for cotton; improved luster, strength, and durability of cotton fabrics.

Cotton mechanical processing -- fiber blending procedures to achieve specific properties in finished cotton fabrics; development of a commercially suitable bale opener-blender; optimal cotton fabric structures for men's trousers and dress suits; improved sewing techniques (including thread) for wash-wear cotton garments.

Improved wool products -- durable-press, machine-washable apparel from blended wool fabrics; new soil-resistant treatments for wool based on fluoro chemicals; new crosslinking agents to give wool dimensional stability at better economic advantages than present Wurlan treatments; studies of wool fabric construction to minimize wrinkling in light-weight wool fabrics; investigations of wool-cotton blends to achieve optimum dimensional stability and appearance during wear and servicing.

Fruits and Vegetables. Development of convenience-in-use fruit and vegetable products, and processing equipment for their economic manufacture, together with fundamental investigations of factors affecting color, texture, and flavor:

Citrus and subtropical fruits -- improved quality control methods for lemon juices and lemon oil; new processes for concentration and dehydration of bananas, guava, pineapple, papaya, and passion fruit; studies of flavor constituents of grapefruit products; improved quality and storage life of foam-mat dried citrus powders.

Deciduous fruits and berries -- development of non-hardening ground raisins for use in the bakery trade; development of new osmosis processes for dehydrating fruit juices to produce superior products; mold preventives for dried fruit in export markets; evaluation of processing characteristics of new fruit varieties; new methods for stripping flavor essence for reincorporation into fruit products; methods to control off-odors in canned ripe olives; investigations to overcome sedimentation in apple juices.

Vegetables -- quick-cooking whole and powdered lima bean products; new enzyme control methods and drying techniques for tomato products; improved explosion-puffed carrots, potatoes, and other vegetables; studies to improve quality of processed potato products; new quick-cooking vegetable products by microwave heating.

Oilseeds. Principal research on soybean, cottonseed, and linseed oils, meals, and related products, with concurrent attention to castor, safflower, crambe, and selected oilseeds resulting from the new crops screening program:

Food uses -- processes for making food products from full-fat soybean flour, corn-soybean-dry milk mixes, peanut flour, cottonseed flour, etc., especially for use in developing countries; improvements in soybean oil through development of new selective hydrogenation catalysts; new outlets for peanuts through development of partial defatting process; new food products utilizing cocoa butter-like fat from cottonseed oil; removal of off-flavor and off-color from safflower oil; controlling toxic metabolites of mold contaminants in oilseed products.

Feed uses -- studies to improve feed qualities of safflower meal; methods for inactivating or removing cyclopropenes and gossypol from cottonseed meal products; basic information on soybean meal proteins.

Industrial uses -- evaluation of new safflower varieties to find optimum ratios of oleic and linoleic acids for specific end uses; new vegetable oil polymers for use in coatings and adhesives; investigations of castor-based urethane foams; new protective coating treatments from linseed and soybean oil; preparation and characterization of derivatives of oilseed monomers.

New and Special Plants. Investigations to develop compositional data on plants from world-wide sources, to find alternate crops to fill needs not now met by domestic sources; and to develop new and more economic uses for special domestic plants:

New alternate crops -- comprehensive surveys of the protein composition of exotic seeds, to point the way to supplementary sources of feed and food proteins; industrialization of new oilseeds, particularly the processing of erucic acid oils, and the development of chemical derivatives from these sources; processes to improve flavor and nutrient properties of crambe meal for feed purposes; industrial uses for crambe oil and derivatives; evaluation of kenaf for pulping uses.

Naval stores products -- new industrial chemicals from pine gum, turpentine, and rosin.

Culture collection -- enhancement of the ARS culture collection, consisting of over 17,000 permanent cultures, used for commercial manufacture of food and industrial products, insecticides, and antibiotics and other pharmaceuticals.

Tobacco -- a broadened program to emphasize studies of physiologically-active compounds in tobacco leaf and smoke, determination of products formed on burning leaf tobacco, effect of added chemicals on smoke composition, and development of rapid bioassay methods and measurement of tobacco smoke condensates by these methods.

Other crops -- improved techniques for manufacturing maple sirups.

Poultry, Dairy, and Other Animal Products. Development of better and more economical food products from poultry, eggs, milk, and meat, and development of new industrial outlets for fats, hides, and other animal byproducts:

Poultry products -- structural changes in poultry meat induced by variations in aging, freezing, thawing, cooking, and related food processing steps; new processes for continuous freeze-drying of raw and cooked chicken meat and other products; factors affecting flavor of cooked poultry meat.

Egg products -- effect of pasteurizing techniques upon egg components and contaminants such as salmonella bacteria; methods for elimination of salmonella from egg products by chemical treatment; chemical, physical, and enzymic means of altering functional properties of egg white leading to new products.

Dairy products -- constituents responsible for stale flavor in dried and concentrated milks; improved vacuum foam-dried whole milk; improved processes for cheesemaking, particularly for enhancing flavor and texture; preparation of anhydrous milk fat and ghee for new food uses; processes to make ultra-high-solids milk concentrates.

Meat products -- new formulations and methods of preparing smoked meat products; methods for modifying flavor, color, and aroma constituents of cured meat products.

Animal fats and hides -- new lubricants, biodegradable detergents, and other industrial chemicals from chemically modified fats; further uses for glutaraldehyde tanning for leather; regenerated collagen products from animal hide materials; dehydration processes for preserving animal hides.

VI FINANCIAL INFORMATION

The F. Y. 1967 and F. Y. 1968 domestic utilization research and development funds under "Salaries and Expenses, Agricultural Research Service," including allotments from the Special Fund for additional labor, are as follows:

| | F. Y. 1967 (Obligations) | Proposed Distribution F. Y. 1968 (Estimated) |
|--|-----------------------------|---|
| Cereal and forage crops | \$ 6,798,717 | \$ 6,777,900 |
| Cotton, wool and other fibers . | 6,166,421 | 6,297,500 |
| Fruits and vegetables | 5,077,753 | 5,097,200 |
| Oilseeds | 4,165,376 | 4,046,000 |
| New and special plants | 2,769,064 | 3,172,800 |
| Poultry, dairy, and animal products | <u>6,638,118</u> | <u>6,685,100</u> |
| Total | \$31,615,449 <u>a/</u> | \$32,076,500 <u>b/</u> |

a/ Includes funds appropriated under the Second Supplemental Appropriation Act, 1967, for increased pay costs pursuant to Public Law 90-21 and wage board increases.

b/ Includes \$755,700 to meet pay costs pursuant to Public Law 89-504 and wage board increases.

In addition to the 1967 total shown above, \$24,627 was obligated under nonrecurring allocations from the Contingency Research Fund for determining transmission of aflatoxin into poultry meat and eggs, and \$25,000 for development of new desert grapefruit products.

Supplemental Information

1. The 1964 Appropriation Act authorized use of \$9,716,000 by transfer of CCC and Section 32 funds, for construction at various regional laboratories and field stations, as follows:

| <u>Location</u> | <u>Amount</u> | <u>Estimated Completion Date</u> |
|----------------------------|----------------|--------------------------------------|
| California, Albany | \$1,550,000 | October 1967 |
| Florida, Olustee | 250,000 | October 1966 |
| Illinois, Peoria | 4,500,000 | April 1968 |
| Louisiana, New Orleans | 1,465,000 | March 1968 |
| Pennsylvania, Wyndmoor | 1,485,000 | October 1967 |
| Texas, Weslaco | 250,000 | October 1966 |
| Georgia, Athens (planning) | <u>216,000</u> | (See also below) |
| Total | \$9,716,000 | |

2. Also in FY 1964, \$9,500,000 was authorized by Section 32 fund transfers for construction of the laboratory at Athens, Georgia. This building, which will constitute the fifth regional research laboratory, is expected to be completed in December 1968.

3. The FY 1968 Appropriation Act provided an additional \$1,200,000 to complete the Athens laboratory at the scale contemplated when the appropriation was made in 1964, and \$50,000 for planning a wool research building at the installation in Albany, California.

4. In addition to the domestic program, the equivalent of approximately \$1.38 million in foreign currencies was obligated in F.Y. 1967 for utilization research projects (largely extending over a five-year period) conducted under agreements with foreign institutions. This work is financed by funds generated under the P. L. 480 program.

5. The F.Y. 1968 Appropriation Act also provides for the following increases:

Staffing, equipping and operating new or expanded research facilities:

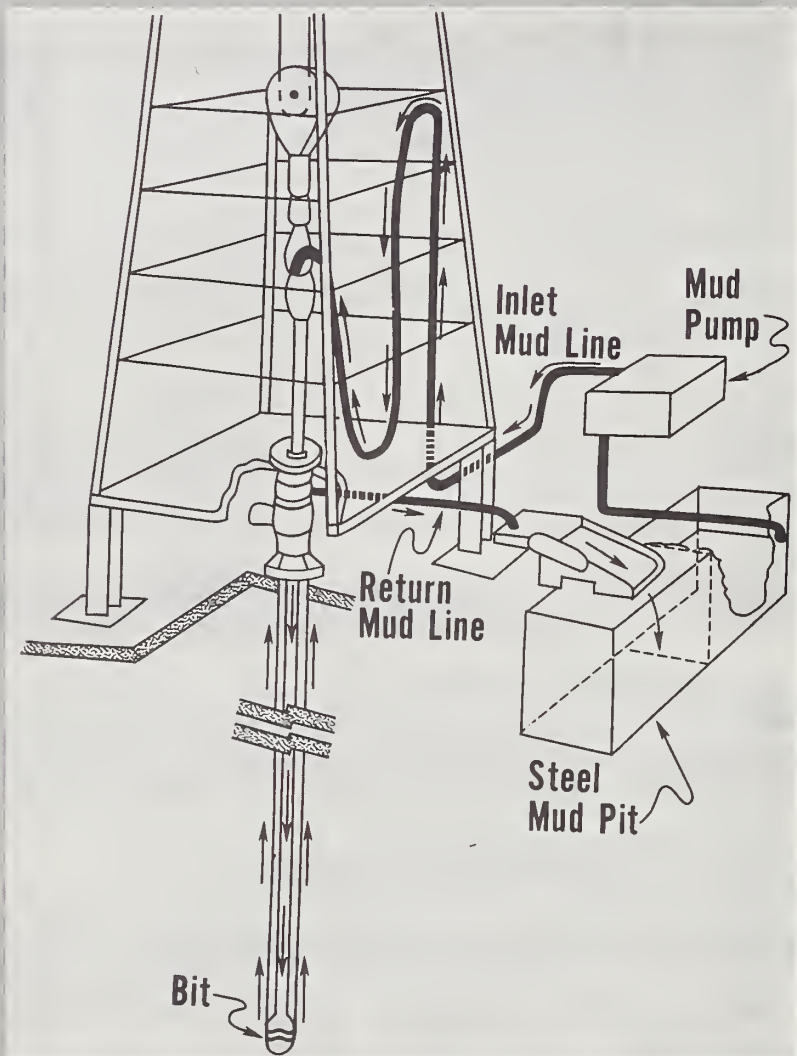
| | | |
|-----------------------|----------------|--------------|
| Albany, Calif. | \$ 402,300 | |
| Pasadena, Calif. | 75,000 | |
| Athens, Ga. | 200,000 | |
| Peoria, Ill. | 393,000 | |
| New Orleans, La. | 319,400 | |
| Wyndmoor, Pa. | <u>394,300</u> | |
| Total | | \$ 1,784,000 |

| | | |
|---|--|----------------|
| Additional rice utilization research, New Orleans, La. | | 25,000 |
| Maple products research, Wyndmoor, Pa. | | 25,000 |
| Additional cotton utilization research, New Orleans, La. (transfer from CCC) | | 137,500 |
| Increased pay costs for shortage category employees | | 306,000 |
| Pay costs pursuant to Public Law 89-504 and wage board ... | | <u>755,700</u> |
| Total | | \$ 3,033,200 |

6. After passage of the Appropriation Act, the following reductions were made to comply with Public Law 90-218:

| | | <u>Reductions</u> |
|--------------------------|----|-------------------|
| Albany, California | \$ | 639,300 |
| Athens, Ga. | | 50,100 |
| Peoria, Ill. | | 717,000 |
| New Orleans, La. | | 652,400 |
| Wyndmoor, Pa. | | <u>567,000</u> |
| Total | \$ | 2,625,800 |

Cereal Starch Gum ... Aid in Oil Well Drilling



POLYSACCHARIDE GUM FOR OIL WELL DRILLING.

Polysaccharide B-1459, a gum produced from corn sugar by a bacterial fermentation process, is an important new agent for controlling the viscosity of oil-well drilling muds. The viscosity of the mud must be high enough to carry the bit cuttings out of the well to the mud pit, where they settle out. The gum is already in commercial use.

VII SELECTED RESEARCH ACCOMPLISHMENTS

Examples of the current program of utilization research were given in a previous section of this report. In the present section are presented 18 selected examples of recent accomplishment under this program. For the most part, these examples concern research that has proceeded through the applied and development stages, to the point of commercial acceptance of the processes or products involved. Some of the accomplishments are illustrated on the facing pages.

Oil Well Drilling Fluids Based on Polysaccharide Gum from Cereal Starches

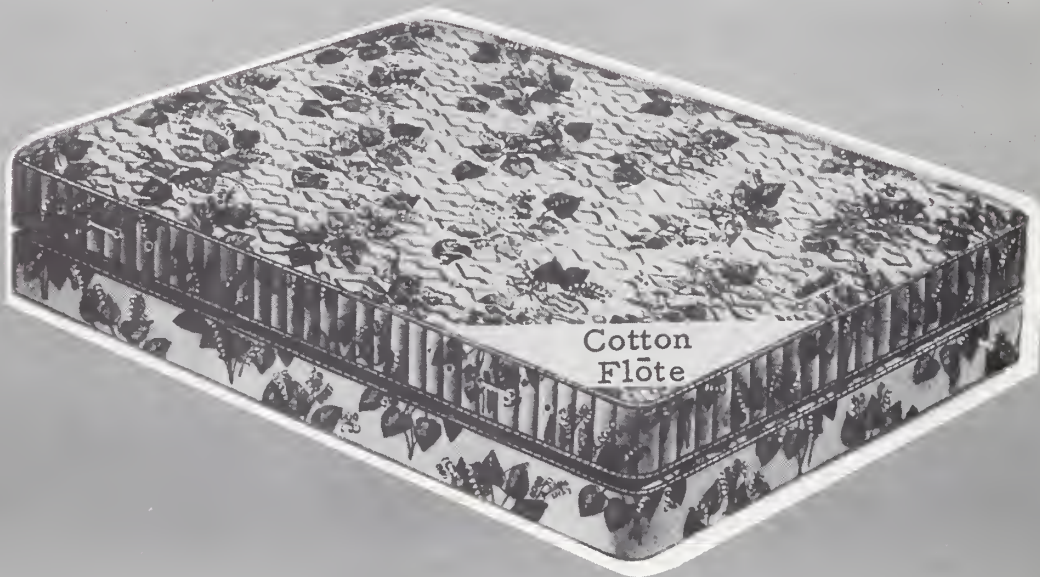
"Polysaccharide B-1459," a gum produced from corn sugar by a bacterial fermentation process, has been selected by industry as the base component for a new oil well drilling mud system. This gum is produced by four industrial companies, using the process developed by the Department. B-1459 solutions in water have unusually high viscosities that are stable over wide ranges of temperatures, salt concentrations, and alkalinities--conditions normally encountered in oil well drilling. Over 20 use patents already have been obtained by industry. Seven major manufacturers of drilling additives have been licensed to use the new drilling fluid.

Specifications Developed for Corn-Soya-Milk (CSM) Blended Food Product

Corn-soya-milk (CSM) blended food product, a balanced food intended as a dietary supplement for children, was developed cooperatively by industrial and Department scientists for use in overseas donation programs by AID, UNICEF, and voluntary agencies. Department scientists conducted extensive processing, storage, analytical, and organoleptic tests on CSM which resulted in specifications for all purchases. These specifications are the basis for the official inspection procedure, and insure a product having uniform quality and characteristics. As of January 1968, about 400 million pounds of CSM had been purchased for distribution in 90 foreign countries.

First Flame-Resistant Mattress...

DEVELOPED THROUGH RESEARCH



FLAME RESISTANT MATTRESS. A completely flame-resistant mattress, recently introduced by a major bedding manufacturer, is based on research achievements by Department scientists. The cotton batting receives a resin treatment to insure resilience; and special flame-retardant treatments are applied to both the batting and the ticking. The mattress represents "a dramatic breakthrough in the field of safety."

The World's First Completely Flame-Resistant Mattress

A full-page advertisement in an industry journal recently announced the introduction of a completely flame-resistant mattress by a major bedding manufacturer. This new product was made possible by three research achievements of Department scientists: the resilient new batting called "Cotton Flote," a special flame-retardant compound that is applied to the batting at the same time as its usual resin treatment, and a different flame-retardant that is used to treat the ticking. The mattress has been rigorously tested and is creating considerable interest in industry. In addition to its important economic implications, the mattress represents, in the words of industry sources, a "dramatic breakthrough in the field of safety."

Demand for "Cotton Flote" Now Exceeds Supply

Cotton Flote--the outstanding cotton batting product developed by Department scientists in cooperation with the Textile Waste Association, the National Cottonseed Products Association, the National Batting Institute, and the Foundation for Cotton Research and Education of the National Cotton Council--has been so enthusiastically accepted by industry that the demand for the product now exceeds the supply of the raw material. Twenty-two companies are licensed to produce the new chemically-treated batting, and at least twelve are either in production or are installing the process in their plants. Current production is estimated to be in excess of 4 million pounds per year. The new batting is currently being used by two major U. S. automobile manufacturers for cushioning; by another firm for insulation in auto trailers and trailer trucks; by at least two bedding companies for high-grade mattresses; and by a segment of the furniture industry for cushioning applications. Cotton Flote appears to have excellent potential for further growth in cushioning markets, with a potential usage of 1.5 million bales of cotton linters and textile wastes annually.

Supergrade Feed from Alfalfa

*USDA Process Now Commercially
Available for...*

BETTER POULTRY FEED



- HIGH PROTEIN
- HIGH XANTHOPHYLL
- LOW FIBER

BETTER CATTLE FEED



- CHEAPER
- BETTER FIBER TEXTURE
- HIGH CARCASS QUALITY

IMPROVED FEED FROM ALFALFA. Dehydrated alfalfa has been fractionated by Department scientists to produce a high-protein, low fiber fraction that is particularly suitable for poultry rations, and a high-fiber fraction for feeding to ruminants. The new process adds over \$7 per ton to the value of the product; it is now commercially available.

New Process Leads to First Commercially Available Supergrade Alfalfa

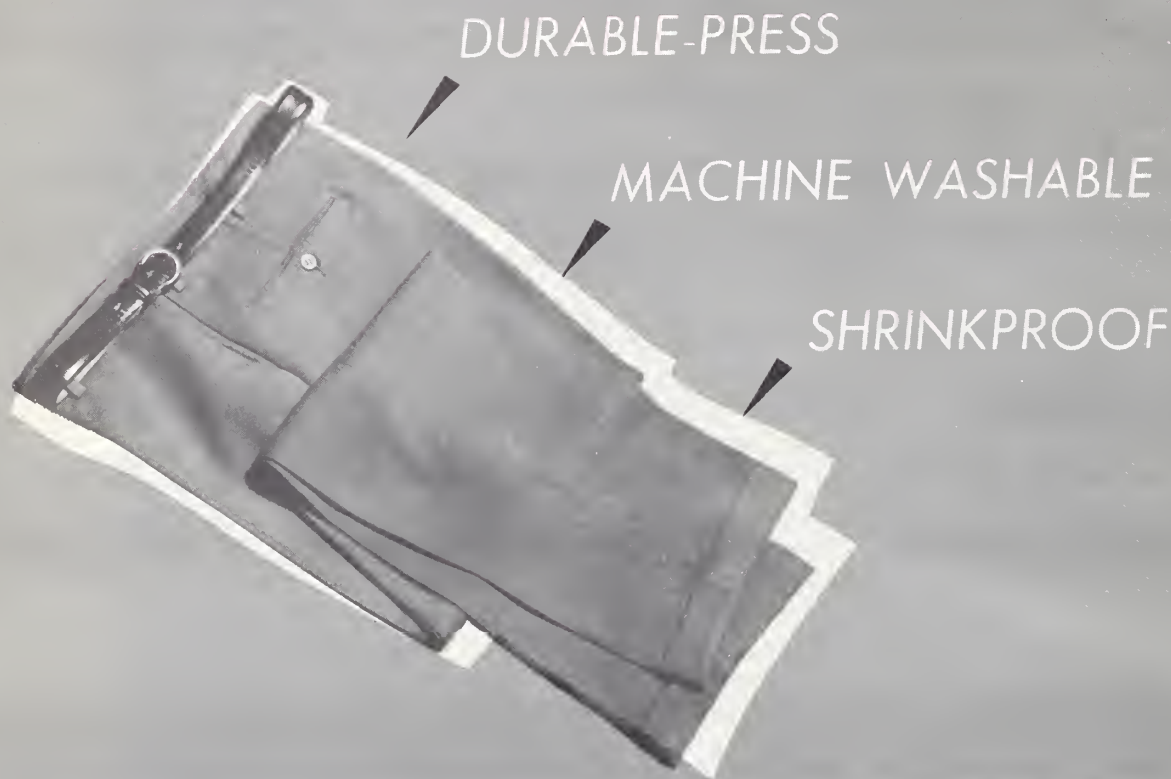
Cooperative work of Department scientists with the Nebraska State Department of Agriculture and with industry has led to development of a process for separating the fibrous fraction from the high-protein fraction of alfalfa after dehydration. The process is based on a differential grinding step, followed by screening or air classification to produce a high-xanthophyll, high-protein product for poultry rations and a high-fiber fraction for ruminants. Based on this work, the first 25 percent protein alfalfa product ever to be made commercially available has recently been announced by a major alfalfa dehydrating company; other firms are expected to adopt the process during the coming year. The present two standard grades of alfalfa meal provide for minimum protein contents of 17 and 20 percent, respectively. The new product is richer in all nutrients measured than the standard grades, and is better suited to poultry because of its greatly reduced fiber content. The process adds over \$7 per ton to the value of dehydrated alfalfa.

New Finishing Agents Widely Adopted by Cotton Textile Industry

New carbamates (urethane derivatives) developed by Department researchers are now being used extensively for the manufacture of wash-wear and durable-press cotton finishing agents. Five carbamates (the methyl, ethyl, hydroxyethyl, hydroxypropyl, and methoxyethyl derivatives) are currently produced commercially; and a new carbamate--the isopropyl derivative--was recently announced by the Department. Consumption of carbamates in wash-wear and durable-press applications in 1965 was estimated at 4 million pounds; present annual usage is considerably higher, and the potential for further growth is excellent. The carbamates produce high-quality-wrinkle-resistant finishes that are inexpensive and durable. Because the finishing agents do not yellow in high-temperature curing or upon exposure to chlorine bleach during laundering, they are equally suitable for both white and colored goods. It is estimated that carbamate finishes are used in the production of about 80 percent of all-white durable-press products, principally shirts, blouses, and the like.

Available to the Consumer...

"NO-IRON" Wool-Blend Slacks



"NO-IRON" DRESS SLACKS. Recent commercial production of true "no iron" dress slacks from wool-blend fabrics was recently inaugurated. The development is the outgrowth of USDA research on blends of settable non-wool fibers with wool that is made shrink-resistant by USDA's "WURLAN" process. The finished garment receives a durable-press treatment. Slacks made in this way can be repeatedly machine-washed and tumble-dried.

Durable-Press Machine-Washable Wool Blend Apparel Commercialized

Commercial production of true "no-iron" dress slacks made from wool-blend fabrics was inaugurated recently. Department scientists paved the way for this development through studies of blends of settable non-wool fibers with wool that is made shrink-resistant by USDA's "WURLAN" process. The finished garment receives a durable-press treatment. Wool-blend slacks made this way can be repeatedly machine washed and tumble dried. Not even touch-up ironing is needed. In addition to outstanding washability, the fabric retains the esthetics, warmth, and resilience of wool. In various weaves, the new wool-blend fabrics are comfortable to wear and exhibit outstanding shape retention, crease retention, and wrinkle-resistant properties.

Primary benefit of this development will be the saving to consumers in costs of pressing and drycleaning. The saving in pressing costs alone should exceed \$50 million annually when the market is fully developed. Additional benefits accrue to the garment cutter through a more salable product, to the fabric maker through an increased net value of his product, and to the wool producer through an increased outlet for wool.

Peach Processing Industry Expands

Two million peach trees of the new clingstone variety "Babygold" have been planted recently in Arkansas, the Carolinas, Illinois, Michigan, New York, Ohio, Pennsylvania, Virginia, and Canada. The superior processing quality of this peach was discovered as a result of USDA contract research at the New Jersey Agricultural Experiment Station. Babygold peaches are highly regarded for making baby-food puree (hence the name) and for canning as halves and slices. The first commercial crop, of 242 tons, was harvested in Arkansas in 1966. A leading baby-food manufacturer processed all of it into peach puree for nationwide distribution.

The Babygold variety is of special importance to Eastern growers who depend almost entirely on the fresh market as the sole outlet for their peaches. It is expected that the Babygold plantings will lead to the construction of new processing plants and to the development of a sizable peach processing industry in the Eastern states.

NEW CONVENIENCE FOOD...

Instant Orange Juice Crystals

◀ FRESH FLAVOR

◀ NUTRITIOUS

◀ NO REFRIGERATION
REQUIRED



INSTANT ORANGE JUICE CRYSTALS. A continuous foam-mat dryer process has been used to develop a new convenience food--orange crystals--from commercial frozen orange concentrate. The product readily dissolves in water to yield a fresh-tasting, nutritious juice; it is light in weight and has substantial shelf life. The Armed Forces are currently using 1.5 million pounds of orange crystals a year, of which a third is produced by the new process.

Orange Crystals for Instant Juice Used by the Armed Forces

Department scientists, in cooperation with the Florida Citrus Commission, have developed a new convenience food--foam-mat dried orange crystals that readily dissolve in water to yield a fresh-tasting, nutritious juice. The crystals are made from commercial frozen orange concentrate by a continuous foam-mat dryer process. Since the product is lightweight and has a shelf life of at least six months at 85°F., it is attractive for commercial export as well as domestic consumption. The Armed Forces are currently using about 1.5 million pounds of orange crystals a year, a third of which are produced by the new process. Industry production is expected to increase initially to 20 million pounds of orange crystals a year, equivalent to 5 million boxes of oranges.

Catalyst for Producing Improved Edible Soybean Oil Commercialized

A catalyst developed by Department scientists for use in production of edible soybean oil having improved flavor stability is now available commercially. The catalyst, a specially activated compound containing copper and chromium, is highly effective in treatment of soybean oil with hydrogen for selective removal of linolenate, the unstable (triply-unsaturated) component of the oil. Oils containing less than 1 percent of linolenate are easily produced with the aid of the new catalyst. At the same time, the content of nutritionally desirable linoleate (doubly-unsaturated) component is increased. Since no hardening of the oil takes place, winterizing to eliminate hardened products is unnecessary. It is anticipated that treated oils will have the stability needed to withstand storage and transportation for foreign marketing. This development will substantially enhance the possibilities for soybeans to play a major role in overcoming the annual world food deficit of 4 billion pounds of food fats and oils.

New Preservative...

*Keeps European Market Open
for U.S. Dried Fruit*



PRESERVATION OF DRIED FRUIT. Department scientists have developed a potassium sorbate treatment for preventing fungus growth on prunes and other high-moisture dried fruit. The treatment has been approved by the West German government for imported fruit. This preservative is not detrimental at concentrations at least as high as 500 parts per million. Total value to the industry of the sorbate treatment of prunes alone is estimated at \$7 million annually.

New European Markets for Dried Fruit

The market for dried prunes in Europe is widening as the result of Department efforts. Utilization research scientists, in cooperation with the Dried Fruit Association of California and the Foreign Agricultural Service, have recently obtained approval from the West German government for the use of potassium sorbate on prunes to a maximum tolerance of 500 parts per million. Previously, dried fruit containing this preservative could not be sold in West Germany. The demonstration that sorbate at this concentration is not detrimental and should therefore be permissible in foods should substantially assist in building markets for the United States dried fruit industry.

The process, developed by Department scientists, for applying potassium sorbate to preserve high-moisture dried fruits is widely used to treat both prunes and figs in domestic markets. The total value to the industry of the sorbate treatment of prunes alone is estimated at about \$7 million annually.

Present European markets for dried prunes are only half as large as before World War II. Access of attractive, high-moisture, sorbate-treated prunes to the West German market is a significant step in expanding foreign markets for dried prunes, which are now at the \$12 million level for Europe.

Macromolecules in Cigarette Smoke

In Department studies on the relationship between cigarette smoking and health, an unusual and complex material--a pigment of very high molecular weight--has been isolated from cigarette smoke. The pigment contains iron, chlorogenic acid, at least 18 amino acids, a silicone material, and several alkaloids, including nicotine. The pigment is the first reported instance of the presence in tobacco smoke of nicotine or other alkaloids in a component of high molecular weight. There is evidence that the smoke pigment comes from a pigment in the tobacco leaf. The unexpected finding of this high-molecular-weight component illustrates the type of fundamental information that will serve as a basis for development of safer smoking products.

USDA Developed Heat Treatment *of* GROUND RAISINS ...



**PROVIDES
NEW
COMMERCIAL
OUTLETS**

*Stabilized Product Permits: Central Processing
Shipping and Longer Storage*

NEW OUTLETS FOR RAISINS. When raisins are ground and stored for a few days, they "set" into a hard mass. A simple USDA process, involving a brief high-heat treatment of the raisins, retards or prevents this difficulty. The superior stability of the heat-treated product permits central processing, shipping, and practical storage by bakeries and candy manufacturers. The process is now in commercial use.

Non-Setting Ground Raisins

When raisins are ground and held at room temperature for just a few days, they "set" into a hard mass. Department scientists have developed a very simple and economical process to cope with this problem. Ground raisins, or whole raisins before grinding, are exposed to high heat for a brief period, thus retarding or preventing subsequent setting. This superior stability permits, for the first time, central processing, shipping, and practical storage by bakeries and candy manufacturers. The product consistency can be adjusted for specific end uses. The process is now in commercial use. By mid-1967, one firm had produced 500,000 pounds. A whole line of new products using ground raisins is in the planning stage. These new products should greatly increase the marketability of raisins.

The increase in value of the ground raisins to the user is much greater than the nominal one cent per pound cost to him of the stabilizing treatment.

Cigar Filler Types Characterized

Four types of cigar filler tobaccos--Pennsylvanian, Colombian, Puerto Rican, and Dominican--have been distinguished from each other objectively through analysis of the tobacco smoke by gas chromatography. Each smoke displayed unique, and hence characteristic, patterns on the chromatograms. Easiest to identify in this manner was Colombian smoke, which also showed the most characteristic flavor and odor. This tobacco type was highest in phenyl acetic acid, a recognized flavor component. Cigar manufacturers will be able, by use of this "fingerprinting" method, to modify and standardize the flavor of their products. The Department conducted this research in cooperation with the Cigar Manufacturers Association, which supported two fellowships on the program.

*Consumer and Producer
Benefit by...*

LOW-FAT PEANUT PRODUCT



NEW PEANUT PRODUCT IS COMMERCIALIZED. Ten companies are already actively involved in commercialization of a new low-fat peanut product developed by USDA research. Most of the oil is removed from the peanuts by mechanical pressing; the pressed peanuts are then swollen in hot water, removed from the water, and roasted. In addition to consumer appeal as a snack item with reduced calories, the partially defatted peanuts may be useful as an ingredient in other processed and convenience foods.

Commercialization of Partially Defatted Peanuts Advances Rapidly

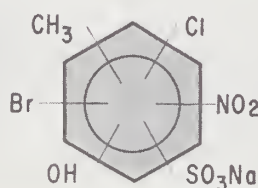
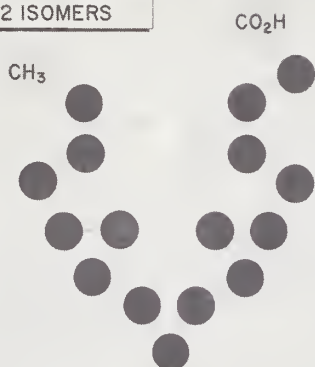
Industry sources have predicted that partially defatted peanuts, a new food product from Department research, will set off "the biggest advance in peanut consumption since man cracked open his first peanut shell." Most of the oil is removed from the peanuts by mechanical pressing; the pressed peanuts are then swollen in hot water, removed from the water, and roasted. Ten companies are already actively involved in various phases of commercialization of the new product: four are commercially producing it; one is producing pressed peanuts for use in making the product; two are conducting and one planning market tests; and two are considering developing products for commercial production. In addition to consumer appeal as a satisfying and nutritious snack with reduced calories, the partially defatted peanuts may be useful as an ingredient in other processed and convenience foods; also, they appear to have potential as a rich source of protein.

Potential New Sources of Vegetable Proteins

The most comprehensive survey ever made of seeds as protein sources has been conducted by Department scientists. Of seed from 4,300 plant species, 535 had more than 35 percent protein. Complete amino acid analyses by precise modern procedures have been made on 380 species to determine their nutritional value. This is over four times the total number of species for which reliable amino acid values were available ten years ago. Seed protein of some species contain amino acids in amounts and proportions that suggest good nutritional balance. Others, while not themselves balanced, are rich in amino acids that are low in present staple vegetable foods and feeds. The data offer a basis for suggesting potential new crops for field trials, feeding tests, and studies of adaptability to the agricultural economy of particular regions of the United States. Such considerations and experiments point the way to promising new feed and food crops for our use and to supplement the world shortage of dietary proteins.

Industrial Chemicals from Surplus Animal Fats

OILY MIXTURE OF
12 ISOMERS



ARYLSTEARIC
ACIDS
FROM
SURPLUS
INEDIBLE
FATS



USES LUBRICANTS, DETERGENTS, ANTIOXIDANTS ETC.

INDUSTRIAL CHEMICALS FROM SURPLUS ANIMAL FATS.

Department scientists have developed several commercial reactions for producing industrial chemicals from the oleic acid in surplus tallow. In the illustration above, a phenylstearic group (the hexagon) is shown attached to an oleic acid molecule (the chain of black circles) to form phenylstearic acid, a viscous oil which remains liquid over a wide temperature range (-58° to $+570^{\circ}$ F.); this compound is a good lubricant and surface active agent. Substituents on the phenyl group make possible a whole series of phenylstearic acids; one of these is hydroxphenylstearic acid, which is useful in lubricants, antioxidants, plasticizers, and resin intermediates. Two large chemical companies are expecting to produce these materials on a commercial scale.

Industrial Chemicals from Surplus Fats

Department scientists have developed several chemical reactions that yield a variety of industrially valuable aromatic compounds from the oleic acid in surplus tallow. For example, phenylstearic acid is a viscous oil that remains liquid over a wide temperature range, from -60° to $+570^{\circ}\text{F.}$; it is a good lubricant and surface-active agent. The properties of another compound, hydroxyphenylstearic acid, make it useful in lubricants, antioxidants, plasticizers, and resin intermediates. Two large chemical corporations have developed industrial processes for making these materials. Phenylstearic acid is expected to sell at 28 to 33 cents per pound, and hydroxyphenylstearic acid at 35 to 40 cents per pound. Within a few years, millions of pounds of phenylstearic acid may find use in the lubricant field alone.

Commercial Use of Foam-Spray Drying for Skim Milk

Foam-spray drying, a technique in which gas is injected into the high pressure liquid-feed line of a spray dryer, has now been applied to the commercial-scale manufacture of nonfat dry milk. In the dryer the gas-liquid-feed mixture is "puffed" into foamed droplets which dry as expanded particles. This product is marketed as an "instant" milk powder, since it can be quickly dispersed in water. A large Connecticut firm recently began making 400,000 pounds of instant powder per year. At least two California milk cooperatives produce foam-spray-dried instant powders for fortifying regular skim milk in the manufacture of cottage cheese and dietary skim milk products. The application of the foam-spray process to the making of dry mixes, specialty products, and animal feeds also has been commanding commercial interest. The elimination of a separate instantizing step provides substantial savings in both capital and operating costs over conventional instantizing equipment.

